APPENDIX A

DRAFT

SAMPLING AND ANALYSIS PLAN
(FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN)
FOR
PRELIMINARY ASSESSMENT/ SITE INVESTIGATION OF BALLFIELDS PARCELS AT DoDHF NOVATO, CALIFORNIA

Contract No.: N47408-01-D-8207
Task Order: 0063

Prepared for:

Naval Facilities Engineering Command
Southwest Division
1220 Pacific Highway
San Diego, CA 92132

Prepared by:

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May 19, 2004

APPROVAL PAGE

DRAFT

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Battelle Project Manager:	Mr. Travis Williamson	Date:	5/19/04
Battelle Program QC Manager:	for Ms. Jennifer Ickes	Date:	5/19/04
SWDIV QA Officer:	Mr. Narciso Ancog	Date:	5/19/04

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APPENDICES

ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
ASTM	American Society for Testing and Materials
bgs	below ground surface
CFR	Code of Federal Regulations
DDT	dichlorodiphenyltrichloroethane
DHS	California Department of Health Services
DI	deionized
DoDHF	Department of Defense Housing Facility
DQO	data quality objective
DTW	depth to water
FID	flame ionization detector
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometer
GPS	Global Positioning System
HMX	1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane
HPLC	high-performance liquid chromatography
IATA	International Air Transportation Association
ID	identification
IDW	investigation-derived waste
IRCDQM	Installation Restoration Chemical Data Quality Manual
LCS	laboratory control standard
LCSD	laboratory control spike duplicate
LQAP	Laboratory Quality Assurance Plan
MCL	maximum contaminant level
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
MS/MSD	matrix spike/matrix spike duplicate
NA	not available
ND	not detected
NEDTS	Navy Environmental Data Transfer Standards
NELAC	National Environmental Laboratory Accreditation Conference
NFESC	Naval Facilities Engineering Service Center
NIST	National Institute of Standards and Technology
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration

PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PDD	perimeter drainage ditch
PE	performance evaluation
PID	photoionization detector
PRG	Preliminary Remediation Goals
PVC	polyvinyl chloride
QA	quality assurance
QAO	quality assurance officer
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RL	reporting limit
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SHSP	Site Health and Safety Plan
SI	site investigation
SIS	Surrogate Internal Standard
SOP	standard operating procedure
SWDIV	Southwest Division Naval Facilities Engineering Command
SWRCB	California State Water Resources Control Board
TNT	trinitrotoluene
TOC	total organic content
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons diesel range
TPH-G	total petroleum hydrocarbons gasoline range
TSA	Technical Systems Audit
U.S. EPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound

DISTRIBUTION LIST

The following persons will be provided copies of the approved Work Plan and any subsequent revisions.

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Elements of EPA QA/R-5 in Relation to this SAP

U.S. EPA QA/R-5 QAPP ELEMENT		Battelle SAP
A1	Title and Approval Sheet	Title and Approval Sheet
A2	Table of Contents	Table of Contents
A3	Distribution List	Distribution List
A4	Project/Task Organization	1.4 Project Organization and Responsibilities
A5	Problem Definition/Background	1.5 Problem Definition/Background
A6	Project/Task Description	1.6 Project/Task Description
A7	Quality Objectives and Criteria	1.7 Quality Objectives and Criteria for Measurement Data
A8	Special Training/Certification	1.8 Special Training/Certification
A9	Documents and Records	1.9 Documentation and Records
B1	Sampling Process Design	2.1 Sampling Process Design (Experimental Design)
B2	Sampling Methods	2.2 Sampling Methods
B3	Sample Handling and Custody	2.3 Sample Handling and Custody
B4	Analytical Methods	2.4 Analytical Methods
B5	Quality Control	2.5 Quality Control Requirements
B6	Instrument/Equipment Testing, Inspection, and Maintenance	2.6 Instrumentation/Equipment Testing, Inspection, and Maintenance
B7	Instrument/Equipment Calibration and Frequency	2.7 Instrument/Equipment Calibration and Frequency
B8	Inspection/Acceptance of Supplies and Consumables	2.8 Inspection/Acceptance of Supplies and Consumables
B9	Nondirect Measurements	2.9 Nondirect Measurements
B10	Data Management	2.10 Data Management
C1	Assessment and Response Actions	3.1 Assessment and Response Actions
C2	Reports to Management	3.2 Reports to Management
D1	Data Review, Verification, and Validation	4.1 Data Review, Validation, and Oversight
D2	Validation and Verification Methods	4.2 Verification and Validation Methods
D3	Reconciliation with User Requirements	4.3 Reconciliation with Data Quality Objectives

Section 1.0: PROJECT MANAGEMENT

This Sampling and Analysis Plan (SAP) has been prepared for the performance of site investigation to collect additional data as needed to evaluate the condition of the site, in terms of both ecological and human health risk. The SAP describes the objectives and locations of sampling activities, as well as field methods and procedures. The SAP also presents project management, design and implementation of measurement systems, assessment/oversight of quality assurance/quality control (QA/QC) issues, data validation, and QA/QC protocols necessary to achieve data quality objectives (DQOs). Furthermore, this SAP describes the procedures for collecting and analyzing groundwater and soil samples at Department of Defense Housing Facility (DoDHF) Novato.

The objectives of this SAP are to provide a rationale for field sampling activities at the project area, describe and establish consistent field sampling procedures, and establish data gathering, handling, and documentation methods that are precise, accurate, representative, complete, and comparable to meet the quality control (QC) requirements for the project and the DQOs. The information collected will be used to identify and evaluate any environmental concerns present at the Ballfields Parcels.

The information presented in this SAP is organized into four groups according to their function and are based on *U.S. EPA Requirements for Quality Assurance Project Plans* (U.S. EPA, 2001) as follows:

A. Project Management – this group is divided into elements that describe general areas of project management, project history and objectives, and roles and responsibilities of the participants.

B. Data Generation and Acquisition – this group is divided into elements that describe the experimental design, sampling and analytical methods, sample handling, and QC requirements.

C. Assessment and Oversight – this group is divided into elements that describe activities for assessing the effectiveness of sample collection and analysis and associated QA/QC requirements.

D. Data Validation and Usability – this group is divided into elements that describe quality assurance (QA) activities that occur after the data generation and acquisition phase of the project has been completed to ensure that data conform to the specified criteria and thus are useful for their intended purpose.

1.1 Title and Approval Page (A1)

The SAP Project Title and Approval sheet is provided as page ii of the SAP.

1.2 Table of Contents (A2)

The SAP Table of Contents is presented beginning on page iii of the SAP.

1.3 Distribution List (A3)

The SAP Distribution List is presented on page vii of the SAP.

1.4 Project Organization and Responsibilities (A4)

Key personnel for this investigation include the Navy Remedial Project Manager (RPM), Navy Quality Assurance Officer (QAO), Battelle Project Manager, Battelle QA/QC Officer, and the Battelle Project Team. Key subcontracted services are anticipated to include the following: analytical laboratories for analysis of water and soil samples; subsurface utility locator for locating subsurface utilities; driller for advancement of soil borings and collection of soil samples; and waste collection services. Key roles and responsibilities for technical staff associated with the work outlined in this SAP are presented in the SAP Distribution Table, which includes contact e-mail addresses and telephone numbers for staff members. The Project Manager will be responsible for maintaining the official, approved SAP and related documents.

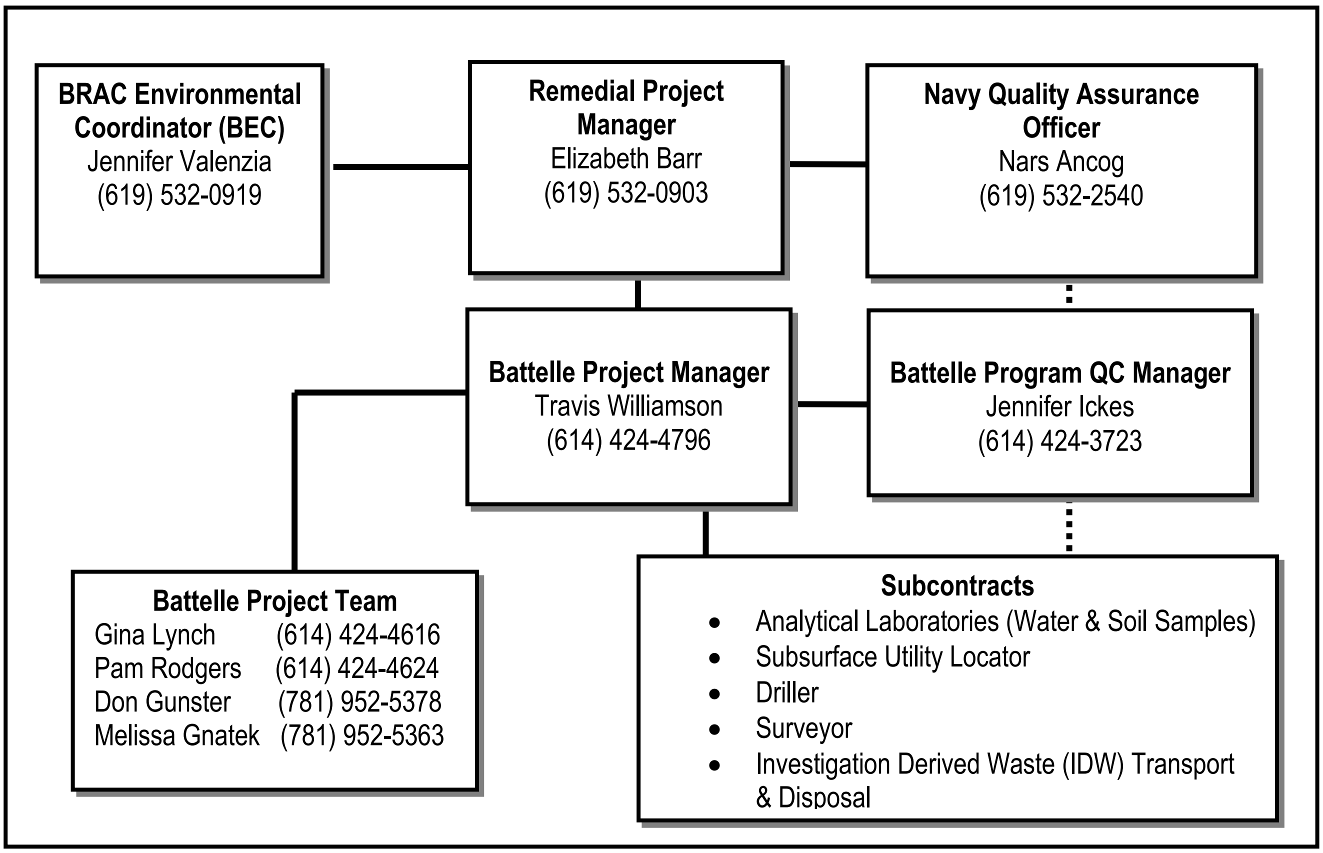

Figure 1-1. Project Organization Chart

1.5 Problem Definition/Background (A5)

The purpose of the activities at the Navy's Ballfields Parcels, DoDHF Novato, is to conduct site investigation work to determine if historical activities have adversely impacted soil and/or groundwater to provide an unacceptable risk to ecological or human receptors.

Table 1-1. Project Personnel and Project Responsibilities

Position	Responsibility(ies)	Authority
Navy QA Officer	• QA oversight for entire program • Review and approval of Work Plans, SAP, and all other QA/QC documents • Review of design process • Communication with Battelle QC Program Manager • Review data validation • Communicating issues to the Navy RPM and Battelle QC Program Manager	• Authorized to suspend field activities if QA requirements are not met
Navy RPM	• Providing final approval for conducting all field activities • Oversight of the overall TO • Approving selected subcontractors • Executing contracts • Approving the release of study reports • Oversight of field and analytical activities	• Suspend work for cause if data quality or staff safety are threatened
Battelle Project Manager	• Budget and scheduling • Engineering design • Work Plan, SAP, and SHSP development • TO team management • Reporting and planning • Navy requirements • Change order recommendation/ justification • Subcontractor work coordination	• Allocate budget among tasks as identified in the Work Plan • Approve all labor, materials, equipment, and subcontractor charges to the project • Assign technical and operational staff to the project • Approve all technical deliverables, including the SAP
Battelle Program QC Manager	• QA/QC requirements approval • Data review • Data validation • Interaction with Navy QA Officer • Laboratory certification • Implement and Manage QC Program at work site • Ensure all data collection is performed according to the approved SAP	• Suspend work for cause if data quality is threatened

Table 1-1. Project Personnel and Project Responsibilities (Continued)

Position	Responsibility(ies)	Authority
Battelle Project Team and Field Personnel	• Perform all sampling in accordance with the approved SAP • Calibrate and maintain field measurement equipment • Complete field documentation • Coordinate laboratory and field sampling activities • Implement field corrective actions as required	• Initiate corrective action
Independent Analytical Laboratories	• Maintain sample chain of custody • Ensure that only staff trained according to the SAP work the projects • Implement the requirements of the SAP for sample analysis, instrument calibration, and data reporting • Conduct corrective action for all failed QC, including reanalysis • Maintain documentation sufficient to provide full data traceability • Archive samples and data according to the SAP retention policy • Contact the Project Manager and/or Program QA Officer when deviations that could affect data quality are identified	• Assign laboratory personnel • Implement corrective action • Report analytical results to Battelle

CO – Contracting Officer.
COR – Contracting Officer Representative.

A detailed description of the areas of interest can be found in the Work Plan. The four issues of potential environmental interest at the Ballfields Parcels include:

- Five former revetment areas, used in the 1940s for airplane refueling and maintenance;
- Two spoils piles dredged from the perimeter drainage ditch (PDD);
- Area-wide dichlorodiphenyltrichloroethane (DDT) applied on the Base; and
- Buildings 191 and 193, used for ordnance storage; Building 193 possibly also used as a transformer switch station.

1.6 Project/Task Description (A6)

The major activities for this task order are as follows:

- Locate and review site records and historic photos associated with the Ballfields Parcels
- Develop a sampling strategy to evaluate areas of interest identified during background research, and prepare a Work Plan, Sampling and Analysis Plan, Site Health and Safety Plan (SHSP), and Ecological Risk Assessment Approach to describe collection of field data.

- Perform fieldwork to address any environmental concerns identified in the background research. Data will be collected to complete a human health screening and ecological risk assessment.
- Prepare a preliminary assessment/site investigation (PA/SI) data report based on field activities at the Ballfields Parcels.
- Provide for site visits and meetings necessary to plan and coordinate project work with representatives of the Navy and regulatory agencies.
- Manage safe waste accumulation and disposal.

1.7 Quality Objectives and Criteria for Measurement Data (A7)

This section presents the DQOs for the project and the performance criteria necessary to meet these DQOs. Included are discussions of the project DQOs, quantitative DQOs (precision, accuracy, and completeness), and qualitative DQOs (comparability and representativeness). The overall QC objective is to generate data that are of known, documented, and defensible quality.

Data Quality Objectives

DQOs are statements that specify the quantity and quality of the data required to support project decisions. DQOs were developed for this project using the seven-step process listed in *Data Quality Objectives Process for Hazardous Waste Site Investigations* (U.S. EPA, 2000). The DQOs are presented in Table 1-2. The QC procedures as well as the associated field sampling procedures for this project will be focused on achieving these DQOs in a timely, cost-effective, and safe manner. Deviations from the DQOs will require defining the cause or causes for noncompliance and will initiate the process of determing whether additional sampling and analyses will be required to attain project goals.

Quantitative Objectives: Precision, Accuracy, and Completeness

Precision quantifies the repeatability of a given measurement. Precision is estimated by calculating the relative percent difference (RPD) of field duplicates, as shown in the following equation:

$$\text{RPD}\,(\%) = \frac{|\text{Result - Duplicate Result}|}{(\text{Result} + \text{Duplicate Result})/2)} \times 100$$

The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken. The analytical precision acceptability limits for this project are listed in Tables 1-3 and 1-4.

Accuracy refers to the percentage of a known amount of analyte recovered from a given matrix. Percent recoveries are estimated using the following equation and can be calculated for the project-specific matrix (i.e., water and solids).

$$\text{Recovery Laboratory Control Standard (LCS) and Surrogate Internal Standard (SIS) (\%)} =$$

$$\frac{\text{Amount Spike Recovered}}{\text{Amount Spike Added}} \times 100$$

Table 1-2. Data Quality Objective Steps for Analysis of Soil and Groundwater Samples

STEP 1 State the Problem	STEP 2 Identify the Decisions	STEP 3 Identify the Inputs to the Decisions	STEP 4 Define Study Boundaries	STEP 5 Develop Decision Rules	STEP 6 Specify Tolerable Limits on Errors	STEP 7 Optimize Sampling Design
To determine if constituents have been released to the soil and groundwater from areas of potential concern (AOPCs): the former revetment areas, spoils piles, area-wide DDT, and ordnance storage buildings. Analytical requirements will be site-specific and are described in Section 2 of this Sampling and Analysis Plan.	Determine if the potential source areas of the Ballfields Parcel present an unacceptable threat to human health and/or the environment, and that the property is acceptable for its planned future use as a seasonal wetland	Validated defensible chemical data resulting from the analysis of soil and groundwater samples collected from within the potential source areas. 77 soil samples and 9 groundwater samples will be collected and analyzed for VOCs, PAHs, PCBs, DDT, TPH-G, TPH-D, TOC, explosives residues, metals, and grain size distribution. Location coordinates (i.e., easting and northing) for sampling locations determined by a California-licensed surveyor. Conservative human health (e.g., Region 9 PRGs) and ecological benchmarks will be used to determine appropriate detection limits (refer to Tables 2-6 and 2-7)	Study boundaries are defined based on available historical information and aerial photographs (AOPCs include former revetment areas, spoils piles, DDT issues and ordnance storage buildings) (See Figure 1-2). The depth of the study will be determined during sample collection, based on depth to groundwater.	If the maximum concentration (or maximum reporting limit) of a chemical constituent in soil or groundwater exceeds conservative risk-based human health screening criteria (i.e., Region 9 Residential PRGs) or risk-based ecological benchmarks, then the chemical will be carried forward in a more site-specific human health evaluation or ecological screening-level risk assessment. If the maximum concentration of chemical constituents in soil or groundwater are below conservative human health and ecological benchmarks and do not pose a risk, then the Ballfields Parcel will be considered acceptable to human health and the environment and further investigation will not be necessary.	Statistical perform-ance parameters have not been determined because limits on decision error will not be considered. Data validation will be performed by a third-party reviewer (i.e., Laboratory Data Consultants).	The proposed sampling locations are based on best professional judg-ment, site history, aerial photos, and results of previous environmental investigations. These areas are expected to have the highest concentrations of COPCs at the site. Therefore, the proposed sampling scheme represents the most resource-efficient design.

Table 1-3. Precision and Accuracy for Groundwater Samples

Analytical Parameter	Analytical Method	Precision (% RPD)	Accuracy LCS/LCSD (% Recovery)
TPH-G	U.S. EPA SW-846 8015B	20	67-136
TPH-D	U.S. EPA SW-846 8015B	20	61-143

VOCs – EPA SW-846 Method 8260B

Analyte	Precision (% RPD)	Accuracy LCS/LCSD (% Recovery)
1,1,1,2-Tetrachloroethane	16	81-129
1,1,1-Trichloroethane	17	67-132
1,1,2,2-Tetrachloroethane	18	63-128
1,1,2-Trichloroethane	20	75-125
1,1-Dichloroethane	20	69-133
1,1-Dichloroethene	15	68-130
1,1-Dichloropropene	17	73-132
1,2,3-Trichloropropane	17	73-124
1,2,3-Trichlorobenzene	20	67-137
1,2,4-Trichlorobenzene	18	66-134
1,2,4-Trimethylbenzene	14	74-132
1,2-Dibromo-3-chloropropane	11	50-132
1,2-Dibromoethane	18	80-121
1,2-Dichlorobenzene	16	75-125
1,2-Dichloroethane	17	68-127
1,2-Dichloropropane	20	75-125
1,3,5-Trimethylbenzene	15	74-131
1,3-Dichlorobenzene	15	75-124
1,4-Dichlorobenzene	16	74-123
2,2-Dichloropropane	20	69-137
2-Chlorotoluene	18	73-126
4-Chlorotoluene	12	74-128
Acetone	20	40-135
Benzene	17	81-122
Bromobenzene	17	76-124
Bromochloromethane	20	65-129
Bromodichloromethane	18	76-121
Bromoform	20	69-128
Bromomethane	20	53-141
Carbon tetrachloride	20	66-138
Chlorobenzene	19	81-122
Chloroethane	16	58-133
Chloroform	20	69-128
Chloromethane	18	56-131
cis-1,2-Dichloroethene	20	72-126
cis-1,3-Dichloropropene	20	69-131
Dibromomethane	20	76-125
Dichlorodifluoromethane	20	53-153
Dichloromethane	30	65-125
Dibromochloromethane	12	66-133
Ethylbenzene	14	73-127
Hexachlorobutadiene	19	67-131
Isopropylbenzene	14	75-127
m,p-Xylene	16	76-128
Methyl-*tert*-butyl ether	30	59-125
Naphthalene	20	54-138
n-Butylbenzene	14	69-137
n-Propylbenzene	14	72-129
o-Xylene	15	80-121
4-Isopropyltoluene	18	75-130
sec-Butylbenzene	14	72-127

Table 1-3. Precision and Accuracy for Groundwater Samples (Continued)

Analyte	Precision (% RPD)	Accuracy LCS/LCSD (% Recovery)
Styrene	16	65-134
tert-Butylbenzene	20	70-129
Tetrachloroethene	20	66-128
Toluene	21	77-122
trans-1,2-Dichloroethene	17	63-137
trans-1,3-Dichloropropene	20	59-135
Trichloroethene	19	70-127
Trichlorofluoromethane	19	57-129
Vinyl chloride	20	50-134
PAHs – EPA SW-846 Method 8270C		
Acenaphthene	20	47-120
Acenaphthylene	20	50-120
Anthracene	28	54-120
Benzo(a)anthracene	25	68-118
Benzo(a)pyrene	26	53-120
Benzo(b)fluoranthene	20	45-124
Benzo(g,h,i)perylene	20	38-123
Benzo(k)fluoranthene	25	45-124
Chrysene	24	55-120
Dibenz(a,h)anthracene	20	42-127
Fluoranthene	20	54-120
Fluorene	20	50-120
Indeno(1,2,3-c,d)pyrene	25	43-125
Naphthalene	20	39-120
Phenanthrene	23	51-120
Pyrene	14	49-128
Explosives – EPA SW-846 Method 8330		
1,3,5-Trinitrobenzene	25	75-142
1,3-Dinitrobenzene	25	75-125
2,4,6-Trinitrotoluene	25	75-128
2,4-Dinitrotoluene	25	75-125
2,6-Dinitrotoluene	25	53-142
2-Amino-4,6-dinitrotoluene	25	75-125
2-Nitrotoluene	25	75-129
3-Nitrotoluene	25	75-112
4-Amino-2,6-dinitrotoluene	25	75-125
4-Nitrotoluene	25	78-108
HMX	25	74-137
Nitrobenzene	25	60-123
RDX	25	75-132
Tetryl	25	44-142
RCRA 8 Metals – EPA Method 6020		
Arsenic	15	80-120
Barium	15	80-120
Cadmium	15	80-120
Chromium (Total)	15	80-120
Mercury	7	77-120
Selenium	15	80-120
Silver	15	80-120
Total Lead	15	80-120

LCS: laboratory control spike.
LCSD: laboratory control spike duplicate
PAHs: polynuclear aromatic hydrocarbons
RPD: relative percent difference
VOCs: volatile organic compounds
RCRA: Resource Conservation and Recovery Act
TPH-D: TPH diesel range
TPH-G: TPH gasoline range

Table 1-4. Precision and Accuracy for Soil Samples

Analytical Parameter	Precision (% RPD)	Accuracy LCS/LCSD (% Recovery)
Petroleum Hydrocarbons – EPA SW-846 Method 8015B		
TPH-G	20	57-146
TPH-D	20	51-153
PAHs – EPA SW-846 Method 8270C		
Acenaphthene	36	46-125
Acenaphthylene	38	44-125
Anthracene	30	53-125
Benzo(a)anthracene	34	52-125
Benzo(a)pyrene	24	50-125
Benzo(b)fluoranthene	32	45-125
Benzo(g,h,i)perylene	24	38-126
Benzo(k)fluoranthene	34	45-125
Chrysene	34	53-125
Dibenz(a,h)anthracene	25	41-125
Fluoranthene	33	54-125
Fluorene	30	49-125
Indeno(1,2,3-c,d)pyrene	25	38-125
Naphthalene	30	40-125
Phenanthrene	30	50-125
Pyrene	33	46-125
Pesticides and PCBs – EPA SW-846 Method 8081/8082		
4,4'-DDD	50	38-146
4,4'-DDE	44	35-149
4,4'-DDT	50	25-153
Aroclor 1016	21	55-130
Aroclor 1221	50	55-130
Aroclor 1232	50	55-130
Aroclor 1242	50	55-130
Aroclor 1248	50	55-130
Aroclor 1254	7	55-130
Aroclor 1260	25	60-122
RCRA 8 Metals – EPA Method 6020		
Arsenic	25	80-120
Barium	25	80-120
Cadmium	25	80-120
Chromium (Total)	25	80-120
Mercury	5	77-120
Selenium	25	80-120
Silver	25	75-120
Total Lead	25	80-120
Explosives – EPA Method 8330		
1,3,5-Trinitrobenzene	25	65-152
1,3-Dinitrobenzene	25	65-135
2,4,6-Trinitrotoluene	25	65-138
2,4-Dinitrotoluene	25	65-135
2,6-Dinitrotoluene	25	65-139
2-Amino-4,6-dinitrotoluene	25	65-135
2-Nitrotoluene	25	65-139
3-Nitrotoluene	25	50-144
4-Amino-2,6-dinitrotoluene	25	65-135
4-Nitrotoluene	25	32-160
HMX	25	64-147
Nitrobenzene	25	25-144
RDX	25	65-142
Tetryl	25	34-152

LCS: laboratory control spike. RPD: relative percent difference LCSD: laboratory control spike duplicate
PCBs: polychlorinated biphenyls TPH-G: TPH gasoline range RCRA: Resource Conservation and Recovery Act
TPH-D: TPH diesel range PAH: polynuclear aromatic hydrocarbon

$$\text{Recovery Matrix Spike/Matrix Spike Duplicate (MS/MSD) (\%)} =$$

$$\frac{\text{(Spiked Sample Result) - (Sample Result)}}{\text{(Spike Added)}} \times 100$$

The recovery of most spiked organic compounds is expected to fall within a range of 70 to 130%. Accuracy ranges for this project are listed in Tables 1-3 and 1-4.

Completeness refers to the percentage of valid data received from actual testing done in the laboratory. Completeness is calculated as shown in the following equation. The target completeness goal for all compounds is 90%. The goal by holding times will be 100%.

$$\text{Completeness (\%)} = \frac{\text{Number of Measurements Judged Valid}}{\text{Total Number of Measurements}} \times 100$$

Qualitative Objectives: Comparability and Representativeness

Comparability is the degree to which one data set can be compared to another. To ensure comparability, samples will be collected at specified intervals and in a similar manner, and will be analyzed within the required holding times by accepted and comparable methods. All data and units used in reporting for this project will be consistent with accepted conventions for environmental matrix analyses. This approach will ensure direct comparability between the results from this project and the results from other projects using the methods presented in this SAP.

Representativeness is the degree to which a sample or group of samples is indicative of the population being studied. Over the course of a project, samples will be collected in a manner such that they are representative of both the chemical composition and the physical state of the sample at the time of sampling.

1.8 Special Training/Certification (A8)

Individuals implementing this SAP must receive, at a minimum, orientation to the project's purpose, scope, and methods of implementation. This orientation is the responsibility of the Program Manager or designee. Field, laboratory, and data management personnel must have documented experience or direct training in the procedures that they will be performing for this project, including any applicable SOPs.

1.8.1 Field Training. Field team members will be adequately trained in sampling methods and procedures outlined in this plan. Specifically, field team members will have training in the following field activities: Geoprobe coring; groundwater sampling; soil sampling; sample handling, packaging, and shipping; and handling of investigation-derived waste (IDW). The Battelle Program QC Manager will maintain training records for all Battelle field personnel as part of the project file. Training records demonstrating compliance with OSHA requirements be posted or on file at the Battelle field office. Subcontractors are responsible for their own training records, however, the Battelle Field Leader will review methods prior to commencing work, and monitor all field sampling operations.

The Field Manager is responsible for identifying worker certification needs for the field unit and ensuring that all team members are adequately trained. A field orientation must be conducted to establish guidelines for field observations between crews to ensure repeatability within the limits of this qualitative approach. This orientation is the responsibility of the Field Manager.

1.8.2 Laboratory Training. Each laboratory technician and analyst must complete an initial demonstration of capability before processing or analyzing samples for this project. At least annually, technicians and analysts must demonstrate continued proficiency for the analyses that they are performing. The procedures used to ensure that staff training is current and documented is defined in laboratory SOPs. The applicable laboratory manager is responsible for determining specific training and certification needs, and for ensuring that any required training is documented.

1.9 Documentation and Records (A9)

The following general types of documents and records will be maintained for this project:

- Work plan
- SAP
- SHSP
- Project logbooks
- Chain-of-custody forms
- General project correspondence
- Laboratory data reports
- Sampling and analysis reports.

The Project Manager is responsible for maintaining the above records to meet the requirements of this SAP. This requirement includes the maintenance of all records and data necessary for QC reports to management, corrective actions, and other associated documentation. Project documentation will be maintained for a minimum of five years following completion of the project.

Section 2.0: FIELD SAMPLING PLAN (DATA GENERATION AND ACQUISITION)

The following sections describe the field activities that will be performed as part of the site investigation at Navy's Ballfields Parcels of DoDHF Novato. These activities include a survey to identify soil boring locations at the Ballfields Parcels for the collection of soil samples and groundwater samples. Approximately 36 soil borings will be advanced on the Ballfields Parcels.

2.1 Sampling Process Design (Experimental Design) (B1)

The proposed field activities and the rationale for sampling locations are discussed in detail in the Work Plan for the Ballfields Parcels. Table 2-1 gives general details of the sampling approach. Five soil borings will be advanced at each of five former revetments. Five soil borings will be advanced at each of the two spoils piles, and one soil boring will be advanced near each of the former ordnance magazines. One groundwater sample will be collected from each revetment, one from each spoils pile, and one from each ordnance magazine. In the area of Revetment 2 and the revetments spoils pile, a total of nine soil borings (not 10) will be advanced, because one sample location will overlap both areas. Figure 2-1 shows proposed boring locations. Two soil samples will be collected at each location, one at the surface and one at depth. The depth of the subsurface soil sample will be determined during sampling, based on the physical appearance of the soils. If soils appear to be stained or impacted in any part of the core, the subsurface sample will be collected from the affected depth. If no visible staining or other indication of contamination is observed, the subsurface soil sample will be collected at approximately 1 foot below ground surface (bgs). Groundwater samples will be collected from the soil borings for laboratory analyses.

2.2 Sampling Methods (B2)

This SAP has been prepared to ensure that the DQOs specified for this project are met, the field sampling protocols are implemented, documented, reviewed in a consistent manner, and the data collected are scientifically valid and defensible.

This section is divided into the following five sections in order to address the sampling and analytical requirements for the major project elements:

- Soil borings
- Soil sampling procedures
- Groundwater sampling procedures
- Investigation-derived waste (IDW)
- Decontamination procedures.

2.2.1 Soil Borings. The approximate lateral and vertical locations of the boreholes and sampling points will be determined using a Global Positioning System (GPS) (or similar). All borehole locations will be cleared prior to advancement for the existence of underground pipes and utilities using ground-penetrating radar and magnetometers.

At the site, thirty-six (36) boreholes will be advanced down to approximately 3-7 feet (or until groundwater is encountered) using a Geoprobe™ direct push method. The direct push method being used at the site will collect continuous cores at each soil boring location in 1.25-inch diameter, 4-ft long, clear polyvinyl chloride (PVC) sleeves. The sleeves will be extracted from the boring and placed in a clean, dry area (e.g., on a folding table covered with plastic) for visual inspection. In most cases, one sample

Table 2-1. Details of Sampling Plan

Location	Sample Matrix	Number of Sample Locations	Total Number of Samples	Analyses	Method
Navy Revetments	Soil	5 per revetment	50 (5 locations, 2 depths, 5 revetments)	TPH-D	EPA SW-846 8015B
				TPH-G	EPA SW-846 8015B
				PAHs	EPA SW-846 8270C
				RCRA metals	EPA SW-846 6020
				TOC	EPA SW-846 9060
				Grain Size Distribution	ASTM D422
	Groundwater(b)	1 per revetment	5 (5 revetments)	TPH-D	EPA SW-846 8015B
				TPH-G	EPA SW-846 8015B
				PAHs	EPA SW-846 8270C
				RCRA metals	EPA SW-846 6020
				VOCs	EPA SW-846 8260B
Spoils Piles	Soil	5 per spoils pile	20 (5 locations, 2 depths, 2 spoils piles)	PAHs	EPA SW-846 8270C
				RCRA metals	EPA SW-846 6020
				TOC	EPA SW-846 9060
				Grain Size Distribution	ASTM D422
				DDT(d)	U.S. EPA SW-846 8081A
	Groundwater(b)	1 per spoils pile	2	PAHs	EPA SW-846 8270C
				RCRA metals	EPA SW-846 6020
Former Ordnance Magazines	Soil	1 per building	4 (2 locations, 2 depths)	Explosives(a)	U.S. EPA SW-846 8330
				TOC	EPA SW-846 9060
				Grain Size Distribution	ASTM D422
				Total PCBs(e)	U.S. EPA SW-846 8082
	Groundwater(b)	1 per building	2	Explosives(a)	U.S. EPA SW-846 8330
TOTAL	**Soil**	**36(c)**	**72(c)**	-	-
	Groundwater(b)	**9**	**9**	-	-

RCRA metals: As, Ba, Cr, Cd, Pb, Se, Ag, Hg   TPH-G: TPH gasoline range   TOC: total organic content
PAHs: polynuclear aromatic hydrocarbons   TPH-D: TPH diesel range
PCBs: polychlorinated biphenyls   VOCs: volatile organic compounds

(a) Explosives will be analyzed using EPA Method 8330, which will detect fourteen common explosives, including 2,4,6-trinitrotoluene (2,4,6-TNT), nitrobenzene, and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX).
(b) Groundwater will be analyzed only if adequate sample volume can be collected. Groundwater will be collected just below the water table.
(c) One soil sample location near Revetment 2 and the Revetments Spoils Pile will be used for both locations.
(d) DDT will be analyzed in one soil sample collected at Revetments Spoils Pile.
(e) Total PCBs will be analyzed in one soil sample collected at Bld 193.

will be collected from the surface, and one sample from below surface. The cores will be visually inspected for any evidence of contaminated soil, and results of the visual inspection will be noted in the field logbook. If the visual inspection indicates contamination, a sample will be taken from that section of the core. If there is no visible evidence of contamination, the sample will be collected from approximately 1 ft bgs. In the event that there is nonnative fill covering the surface of a proposed sampling location, both samples will be collected at depth; one sample will be collected from the approximate elevation of the original ground surface, and one from depth.

2.2.2 Soil Sampling Procedures. Soil samples will be collected and then analyzed for the chemicals indicated in Table 2-2. Soil will be transferred from either a sleeve, auger, or backhoe bucket into a glass jar (or Encore™ samplers for TPH-G analysis) before being sent to the analytical laboratory for chemical preservation and analysis.

Soil samples will be collected from the vadose zone and capillary fringe at selected depths and locations. Soil sampling will be conducted as follows:

1. The Geoprobe coring equipment, and all associated sampling equipment will be decontaminated using the decontamination procedures for field equipment described in Section 2.2.5.

2. The Geoprobe coring equipment and sleeves will be advanced to collect soil cores at each sampling location.

3. Due to the volatile nature of gasoline range organics, Encore™ samplers (or equivalent) will be used to collect soil samples for TPH-G analysis. The TPH-G samples will be collected immediately with as little disturbance possible, capped using EnCore™ samplers, chilled, and shipped to the analytical laboratory. Refer to Appendix A for a more detailed description of the Encore ™ soil sampling procedure that will be followed.

4. The sleeve to be used for laboratory analysis will be removed from the sampler. Glass jars or similar airtight containers will be used to retain samples from the sleeve.

5. All soil samples will be immediately sealed in an airtight jar, labeled, and placed in an ice chest or a refrigerator, where they will be maintained at approximately 4°C until shipment for analyses.

6. All remaining soil samples will be used for lithologic logging purposes and then properly disposed.

Table 2-2. Analytes and Frequency for Soil Samples Collected at Each Location

Site(s)	Analyte	Sample Frequency
Navy Revetments	TPH-D	All soil samples
	TPH-G	All soil samples
	PAHs	All soil samples
	RCRA metals	All soil samples
	TOC	One surface sample from each revetment
	Grain Size Distribution	One surface sample from each revetment
Spoils Piles	PAHs	All soil samples
	RCRA metals	All soil samples
	TOC	One surface sample from each spoils pile
	Grain Size Distribution	One surface sample from each spoils pile
	DDT, DDE, DDD	One soil sample from Revetment Spoils Pile
Former Ordnance Magazines	Explosives[(a)]	All soil samples
	total PCBs	One sample from Bldg 193
	TOC	One surface sample from each building
	Grain Size Distribution	One surface sample from each building

TPH-D: TPH diesel range
TPH-G: TPH gasoline range
PAHs: polynuclear aromatic hydrocarbons
RCRA metals: As, Ba, Cr, Cd, Pb, Se, Ag, Hg
TOC: total organic content
PCBs: polychlorinated biphenyls

(a) Explosives will be analyzed using EPA Method 8330, which will detect 14 common explosives, including 2,4,6-trinitrotoluene (2,4,6-TNT), nitrobenzene, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and tetryl.

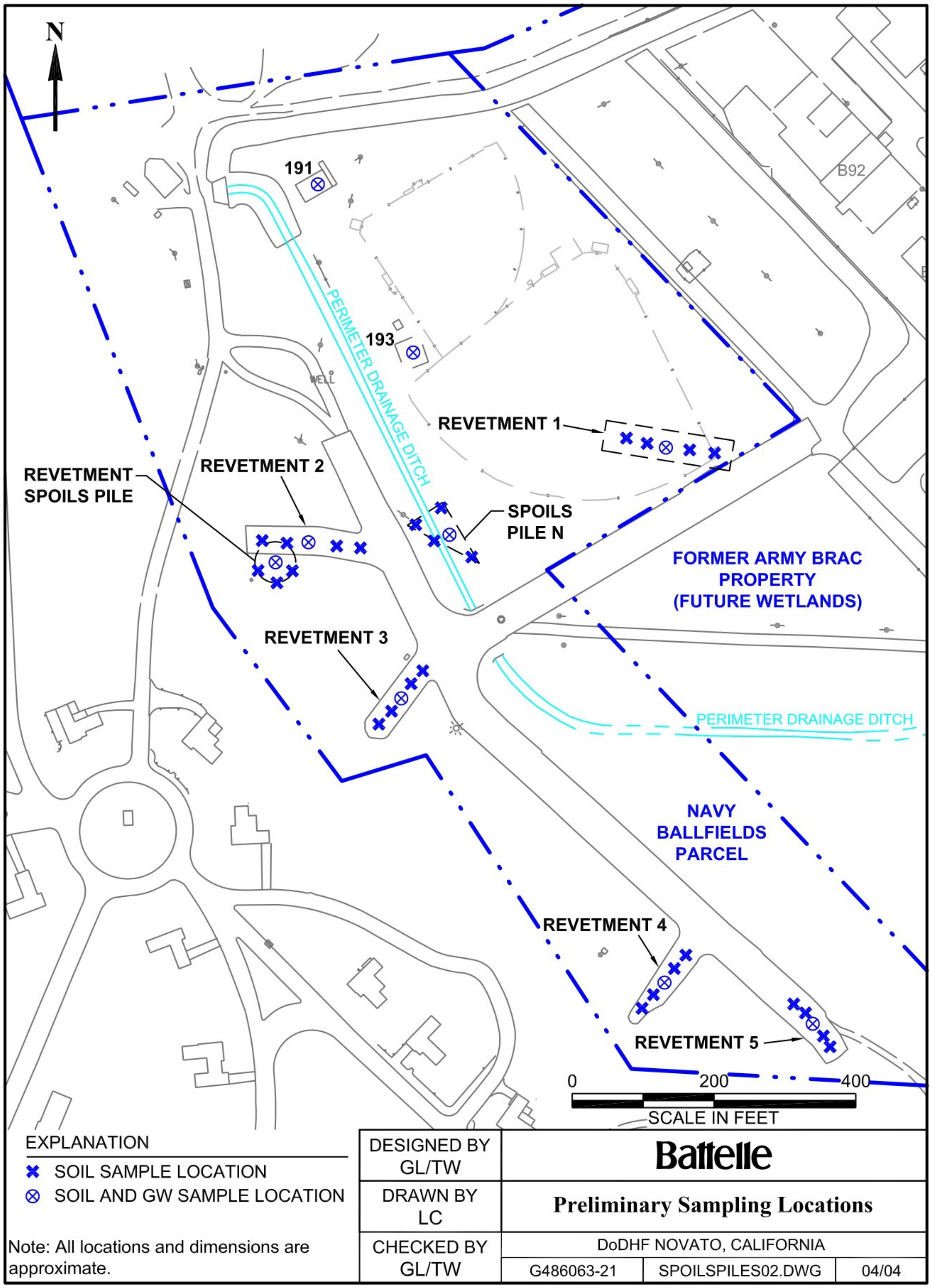

Figure 2-1. Proposed Sampling Locations

2.2.3 Groundwater Sampling Procedures. Several groundwater samples will be collected as part of the site assessment at the Ballfields Parcels. The samples will be analyzed for analytes indicated in Table 2-3. Groundwater and soil chemical analyses will be performed by a California Department of Health Services (DHS)-certified and Naval Facilities Engineering Service Center (NFESC)-approved laboratory using approved methods.

Table 2-3. Analytes and Frequency for Groundwater Samples Collected at Each Location

Site(s)	Parameters	Sample Frequency
Navy Revetments	TPH-G	All water samples
	TPH-D	All water samples
	PAHs	All water samples
	VOCs	All water samples
	RCRA Metals	All water samples
Spoils Piles	PAHs	All water samples
	RCRA Metals	All water samples
Former Ordnance Magazines	Explosives[a]	All water samples

TPH-D: TPH diesel range
TPH-G: TPH gasoline range
PAHs: polynuclear aromatic hydrocarbons
RCRA metals: As, Ba, Cr, Cd, Pb, Se, Ag, Hg
VOCs: volatile organic compounds

(a) Explosives will be analyzed using EPA Method 8330, which will detect fourteen common explosives, including 2,4,6-trinitrotoluene (2,4,6-TNT), nitrobenzene, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and tetryl.

Nine (9) locations will be selected for groundwater sampling. Groundwater samples will be collected from soil borings. PVC well casing terminating with a 1-ft to 5-ft screen section will be lowered into the borehole, and allowed to fill with groundwater to the hydraulic gradeline elevation. A small peristaltic pump and dedicated tubing will be used collect water from the temporary well and to dispense the water into vials for laboratory analysis. Samples will be collected in approved sample containers for the appropriate type of analysis to be performed. Table 2-4 lists sampling methods and the appropriate sample containers, holding times, and preservation methods associated with each method. After the sample container has been filled with groundwater, a Teflon™-lined cap will be screwed on tightly to prevent the container from leaking. Field personnel will exercise care to minimize losses of VOCs and to minimize the turbidity of groundwater during sampling.

Before the sample is collected, depth to water (DTW) measurements will be taken to an accuracy of 0.01 ft using an oil/water interface probe. The oil/water interface probe will be decontaminated as described in Section 2.2.5. The measurements will be checked by slowly raising and lowering the tape and watching the instrument response. The measurement will be recorded in the field logbook. Note that these DTW measurements will be for informational purposes only. They will not be used to develop groundwater flow directions and maps, as the data being collected from the temporary push points will likely not be representative of the actual hydraulic conditions in the area.

2.2.4 Investigation-Derived Wastes. IDW will be produced during the site investigation at the Ballfields Parcels. The soil boring efforts will produce various types of IDW, including soil cuttings, purge water, and decontamination water.

2.2.4.1 Solid Waste. The drilling effort will produce soil cuttings, which will be stored temporarily in an appropriate container. The soil analytical results from samples will be used to characterize the waste prior to disposal. A private contractor will be procured to remove all IDW from the base and dispose of it properly. Original copies of the manifest and disposal notification forms will be provided to the transporter for shipment. Copies of waste manifests and receipts for the disposal of wastes will be retained.

2.2.4.2 Liquid Waste. The decontamination and groundwater sampling activities will produce waste-water, which will be stored temporarily in an appropriate container. The wastewater will be sampled and analyzed prior to disposal. Proper manifesting, transportation and disposal will be followed in accordance with all applicable local, state, and federal laws.

Liquid waste samples for waste characterization will be collected using disposable bailers. The samples will be collected in new, precleaned bottles with the appropriate preservative provided by the analytical laboratory. The samples will be labeled and packaged for laboratory submittal. The following summarizes the sampling procedure to be used:

1. Obtain a disposable bailer. A new bailer shall be obtained for each sample event.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Secure bailer with nylon cord.
4. Lower bailer into the 55-gallon drum or other appropriate container. Allow sufficient time for the bailer to fill with water.
5. Retrieve bailer and fill appropriate bottles for analyses being requested.
6. Cap the bottles and wipe any moisture from outside the bottles.
7. Place a sample label, completed with the sample information on bottle.
8. Place sample bottle in a cooler with ice for shipment to the analytical laboratory.

2.2.5 Decontamination Procedures

Decontamination will be conducted using a five-step process on all field equipment to avoid cross contamination between samples and to ensure the health and safety of field personnel. Decontamination water will be collected in an appropriate container and disposed of according to the previous section. The following sequence will be used to clean equipment and sampling devices prior to and between each use:

- Rinse with potable water.
- Wash with Liquinox™ detergent and tap water and clean with a stiff-bristle brush.
- Rinse with deionized (DI) water.
- Rinse with reagent-grade methanol.
- Place the sampling equipment on a clean surface and air-dry.

2.2.6 Field Corrective Action. Corrective actions may be initiated by any of the participants of the field data generation process (i.e., field technicians, field team, or project manager). It is important to generate corrective actions early in the field sampling process so that the problem has a greater chance of being resolved in a timely and cost-effective manner.

Table 2-4. Sample Containers, Holding Times, and Preservation Methods for Groundwater and Soil

Method	Parameters	Preservation	Container	Holding Time
		Aqueous		
EPA SW-846 8015B[(a)]	TPH-G	Cool, 4°C	1-500 mL, Amber Glass	14 days
EPA SW-846 8015B[(a)]	TPH-D	Cool, 4°C	1-500 mL Amber, Glass	Extract within 7 days/ Analyze within 40 days of extraction
EPA SW-846 8260B [(a)]	VOCs	pH<2, 1:1 HCl, Cool, 4°C	3-40 mL, Glass	14 days
EPA SW-846 8270C	PAHs	Cool, 4°C	2-500 mL, Amber Glass	Extract within 7 days/ Analyze within 40 days of extraction
EPA SW-846 6020	RCRA Metals	Cool, 4°C, Nitric Acid	1-250 mL, Plastic	Analyze within 6 months, except Hg, which is 28 days
EPA SW-846 8330	Explosives	Cool, 4°C	2-500 mL, Amber Glass	Extract within 7 days/ Analyze within 40 days of extraction
		Soil		
EPA SW-846 8015B	TPH-G	Cool, 4°C	Encore™ Sampler (or equivalent)	48 hours
EPA SW-846 8015B	TPH-D	Cool, 4°C	4 oz glass jar	Extract within 14 days/ Analyze within 40 days of extraction
EPA SW-846 8270C	PAHs	Cool, 4°C	4 oz glass jar	Extract within 14 days/ Analyze within 40 days of extraction
EPA SW-846 6020	RCRA Metals	Cool, 4°C	4 oz glass jar	Analyze within 6 months, except Hg, which is 28 days
EPA SW-846 8081/8082	PCBs and DDTs	Cool, 4°C	4 oz glass jar	Extract within 14 days/ Analyze within 40 days of extraction
EPA SW-846 8330	Explosives	Cool, 4ºC	8 oz glass jar	Extract within 14 days/ Analyze within 40 days of extraction
EPA SW-846 9060	TOC	Cool, 4°C	4 oz glass jar	28 days
ASTM D422	Grain size	none required	4 oz glass jar	6 months

TPH-D: TPH diesel range
TPH-G: TPH gasoline range
PAHs: polynuclear aromatic hydrocarbons
TOC: total organic content
RCRA metals: As, Ba, Cr, Cd, Pb, Se, Ag, Hg
VOCs: volatile organic compounds
PCBs: polychlorinated biphenyls

(a) Zero headspace (i.e., no air bubbles) is required for this method.

For field measurements, if the final calibration check on any of the field sampling equipment is outside acceptable limits, then the associated data collected that day will be flagged. On the following day, a single point continuing calibration check will be run after every five measurements to determine how long the calibration holds. Calibration frequencies will be adjusted accordingly.

2.3 Sample Handling and Custody (B3)

This section presents sample handling and custody procedures. These procedures will ensure proper handling, custody, and documentation of the samples from field collection through laboratory analyses.

2.3.1 Sample Containers, Preservation and Holding Time. Requirements for sample containers, preservation, and holding times are listed in Table 2-4. New, precleaned sample containers will be used for water and soil sample collection. Once collected, each containerized sample will be labeled and placed into a matrix-specific sample cooler. The sample cooler will serve as the shipping container and will be packed with ice to cool samples to the appropriate temperature for preservation.

2.3.2 Sample Numbering. Each sample collected will be given a unique sample identification (ID). The sample ID is project specific and a record of all sample IDs will be kept with the field records and recorded on a chain-of-custody (COC) form. The labelling scheme for sample identification will include site identification number and monitoring well number (i.e., R1-GW01; SPN-GW01) for groundwater samples, or site number, soil boring number, and sample depth (i.e., R1-SB01-0') for soil samples.

2.3.3 Sample Labeling. Each sample collected for a project will have a sample label affixed to the outside of the container in an obvious location. All information will be recorded on the label with water-resistant ink. The exact sample label information will include the sample identification number, date and time of sample, preservation used, analytical methods, and site name.

2.3.4 Sample Custody. All samples collected under this Task Order will be logged onto a COC form in the field prior to shipment or pickup by the laboratory. The COC form will be signed by the individual responsible for custody of the sample containers, and the original will accompany the samples to the laboratory. One copy of the COC form will be kept by the project manager and included in the project files. Information to be recorded on the COC should include:

- Sample matrix
- Sample collector's name
- Dates/times of sample collection
- Sample identification numbers
- Number and type of containers for each sample aliquot
- Type of preservation
- QC sample designation
- Analysis method
- Special handling instructions
- Destination of samples
- Name, date, time, and signature of each individual releasing the shipping container.

The laboratory will designate a sample custodian. This individual is responsible for inspecting and verifying the correctness of the chain-of-custody records upon sample receipt. The sample custodian will accept the samples by signing the COC and noting the condition of the samples in the space provided on the COC or other receipt form. The sample custodian will notify the Project Team

Leader of any discrepancies. The COC is generally considered to be a legal document and thus will be filled out legibly and as error free as possible.

Samples received by the laboratory will be entered into a sample management system, which must include:

- Laboratory sample number
- Field sample designation
- Analytical batch numbers
- List of analyses requested for each sample container.

Immediately after receipt, the samples will be stored in an appropriate secure storage area. The laboratory will maintain custody of the samples as required by the contract or until further notification by the Battelle Project Manager. The analytical laboratory will maintain written records showing the chronology of sample handling during the analysis process by various individuals at the laboratory.

2.3.5 Sample Packing and Shipment. Immediately after sample collection, sample labels will be affixed to each sample container. Water and soil samples will be placed in a matrix-specific ice chest or cooler. The samples will be packed with shock-absorbent materials, such as bubble wrap, to prevent movement or breakage of the sample jars during transport. The ice chest will be fillled with wet ice which will be double bagged in resealable bags in order to meet the temperature requirements ($4 \pm 2°C$). A temperature blank will accompany each cooler. Sample cooler drain spouts (if present) will be taped from the inside and outside of the cooler to prevent any leakage.

The COC will be placed in a resealable bag and taped to the lid of the cooler. The ice chest will be banded with packaging tape and custody seals will be placed along the ice chest lid in order to prevent or indicate tampering. The cooler containing the environmental samples will either be picked up by the laboratory or arrangements will be made to have the cooler delivered to the laboratory by an overnight delivery service such as Federal Express. International Air Transportation Association (IATA) regulations will be adhered to when shipping samples by air courier services. If an overnight delivery service is used, the package must be scheduled for priority overnight service to ensure that the temperature preservative requirement is not exceeded. Saturday deliveries will be coordinated with the laboratory.

2.3.6 Field Documents and Records. A project-specific field logbook will be used to provide daily records of significant events, observations, and measurements during field investigations. The field logbook also will be used to document all sampling activities. All logbook entries will be made with indelible ink to provide a permanent record. Logbooks will be kept in the possession of the field team leader during the on-site work and all members of the field team will have access to the notebook. These notebooks will be maintained as permanent records. Any errors found in the logbook will be verified, crossed-through, and initialed by the person discovering the error.

The field notebooks are intended to provide sufficient data and observations to reconstruct events that occurred during field activities. Field logbooks should be permanently bound and prepaginated; the use of designated forms should be used whenever possible to ensure that field records are complete. The following items are examples of information that may be included in a field logbook:

- Name, date, and time of entry
- Names and responsibilities of field crew members
- Name and titles of any site visitors

- Descriptions of field procedures, and problems encountered
- Number and amount of samples taken at each location
- Details of sampling location, including sampling coordinates
- Sample identification numbers of all samples collected
- Date and time of collection
- Sample collector
- Sample collection method
- Decontamination procedures
- Field instrument calibration and maintenance
- Field measurements (e.g., DO, ORP, temperature, pH, and conductivity) and general observations.

2.4 Analytical Methods (B4)

This section presents criteria for laboratory selection and discusses methods to be used for analyses of groundwater, soil, and IDW samples.

2.4.1 Laboratory Selection. An analytical laboratory that has successfully completed the Navy evaluation process through the NFESC will perform all analyses, unless specified otherwise by the Navy. Aqueous and soil samples for this task order will be analyzed by a California-certified and NFESC-approved laboratory. This laboratory will perform all analyses in accordance with the latest version of the Navy Installation Restoration Chemical Data Quality Manual (IRCDQM) (U.S. Navy, 1999).

Battelle's Project Manager will communicate sampling and analysis schedules to the laboratory with sufficient lead-time to meet contractual agreements with the laboratory.

2.4.2 Laboratory Analytical Methods. Laboratory analytical methods were selected based on the project DQOs and in consideration of the method detection limits (MDL) achievable for each parameter. Each laboratory analytical method was chosen to address the intended use of the sampling data. Table 2-5 presents the laboratory analytical methods that are to be used during the field activities.

2.4.3 Quantitative Reporting Limits. Factors that influence the quantitative reporting limits of analytical methods include the analytical method itself, sample matrix interference, and high concentrations of the target analyte. Actual reporting limits may vary from sample to sample in accordance with standard laboratory practices. Tables 2-6 and 2-7 provide the reporting limits for the analytical methods used for the soil and groundwater analyses, respectively, in addition to the screening level for each analyte. For soils, both the EPA Region 9 PRGs are given, as well as a soil screening number developed by Battelle's team to evaluate the potential of ecological risk. The development of these soil screening values is explained more completely in Appendix C of the work plan.

2.5 Quality Control Requirements (B5)

QA is an integrated system of activities in the area of quality planning, assessment, and improvement to provide the project with a measurable assurance that the established standards of quality are met. QC checks, including both field and laboratory, are specific operational techniques and activities used to fulfill the QA requirements.

Table 2-5. Laboratory Analytical Methods

Analytical Parameter	Sample Matrix	Analytical Method
VOCs	Aqueous	U.S. EPA SW-846 5030B/8260B
PAHs	Aqueous	U.S. EPA SW-846 3510/8270C
TPH-G	Aqueous	U.S. EPA SW-846 5030B/8015B
TPH-D	Aqueous	U.S. EPA SW-846 5030B/8015B
RCRA Metals	Aqueous	U.S. EPA SW-846 3015/6020
Explosives[a]	Aqueous	U.S. EPA SW-846 8330
DDT	Soil	U.S. EPA SW-846 8081A
PAHs	Soil	U.S. EPA SW-846 3545/8270C
TPH-G	Soil	U.S. EPA SW-846 5035/8015B
TPH-D	Soil	U.S. EPA SW-846 5030/8015B
PCBs	Soil	U.S. EPA SW-846 8082
RCRA Metals	Soil	U.S. EPA SW-846 3051/6020
Explosives[a]	Soil	U.S. EPA SW-846 8330
TOC	Soil	U.S. EPA SW-846 9060
Grain Size Distribution	Soil	ASTM D422

TPH-D: TPH diesel range
TPH-G: TPH gasoline range
PAHs: polynuclear aromatic hydrocarbons
TOC: total organic content
RCRA metals: As, Ba, Cr, Cd, Pb, Se, Ag, Hg
VOCs: volatile organic compounds
PCBs: polychlorinated biphenyls

(a) Explosives will be analyzed using EPA Method 8330, which will detect fourteen common explosives, including 2,4,6-trinitrotoluene (2,4,6-TNT), nitrobenzene, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and tetryl.

2.5.1 Field Quality Control. The field QC samples will be assigned unique sample numbers and will be submitted to the analytical laboratory. If abnormalities are detected in field QC samples, the data associated with the QC samples will be flagged and appropriate actions will be taken to rectify issues.

Field Duplicate Samples. Field duplicate/replicate samples will be collected at a rate of 10% of the total number of water samples during each groundwater sampling event. If fewer than 10 water samples are collected, one duplicate sample will be collected. For all water samples, duplicate samples will be collected by retaining consecutive samples from the sampling device.

Field duplicate samples will not be collected for any soil samples collected during field activities because sample variability is likely and it would be difficult to produce consistent results between soil samples.

Source Blank. Source blanks will be collected from each source of water that is used to decontaminate sampling equipment or materials to ensure that contamination is not originating from any particular sources of water.

Equipment Rinsate Blanks. Equipment rinsate blanks will be collected daily, during groundwater sampling only, to ensure that nondedicated sampling devices have been decontaminated effectively. Equipment rinsate blanks will consist of the rinsewater used in the final step of the sampling equipment decontamination procedure. Rinsate samples will be collected at a frequency of one per day during sampling events.

Table 2-6. Analytical Laboratory Reporting Limits for Soil (mg/kg)

Analytical Parameter	Analytical Method	MDL	RL	Screening Levels RWQCB[d]	Screening Levels PRG[a]
Gasoline Range Organics	EPA SW-846 8015B	0.6	2	100	NA
Diesel Range Organics	EPA SW-846 8015B	30	100	500	NA

Analyte	MDL	RL	Screening Levels RWQCB[d]	Screening Levels PRG[a]	Analyte	MDL	RL	Screening Levels RWQCB[d]	Screening Levels PRG [a]
PAHs – EPA SW-846 8270C (mg/kg)									
Acenaphthene	0.02	0.05	19	3700	Chrysene	0.02	0.05	3.8[c]	62
Acenaphthylene	0.01	0.05	13	NA					3.8[b]
Anthracene	0.01	0.05	2.8[c]	22000	Dibenz(a,h)anthracene	0.02	0.05	0.11[c]	0.062
Benz(a)anthracene	0.02	0.05	0.38[c]	0.62	Fluoranthene	0.01	0.05	40[c]	2300
Benzo(a)pyrene	0.03	0.05[e]	0.04[c]	0.062	Fluorene	0.01	0.05	8.9	2700
Benzo(b)fluoranthene	0.02	0.05	0.38	0.62	Indeno(1,2,3-c,d)pyrene	0.01	0.05	0.38[c]	0.62
Benzo(g,h,i)perylene	0.02	0.05	27[c]	NA	Naphthalene	0.01	0.05	4.5	56
Benzo(k)fluoranthene	0.03	0.05	0.38[c]	6.2	Phenanthrene	0.01	0.05	11[c]	NA
				0.38[b]	Pyrene	0.02	0.05	85[c]	2300
PCBs – EPA SW-846 8082 (mg/kg)									
Aroclor 1016	0.05	0.1	0.4[c]	3.9	Aroclor 1248	0.05	0.1	0.4[c]	0.22
Aroclor 1221	0.05	0.1	0.4[c]	0.22	Aroclor 1254	0.05	0.1	0.4[c]	0.22
Aroclor 1232	0.05	0.1	0.4[c]	0.22	Aroclor 1260	0.05	0.1	0.4[c]	0.22
Aroclor 1242	0.05	0.1	0.4[c]	0.22	—	-	-	-	-
Organochlorine pesticides – EPA SW-846 8081 (mg/kg)									
4,4'-DDD	0.002	0.005	2.4	2.4	4,4'-DDT	0.002	0.005	1.7[c]	1.7
4,4'-DDE	0.002	0.005	1.7	1.7	—	-	-	-	-
RCRA 8 Metals – EPA SW-846 3051/6020 (mg/kg)									
Arsenic	0.5	1	5.5[c]	22	Mercury	0.016	0.04	2.5[c]	23
Barium	0.5	2	750	5400	Selenium	0.03	0.5	10[c]	390
Cadmium	0.02	0.06	1.7[c]	37	Silver	0.1	0.2	20[c]	390
Chromium (Total)	0.5	2	58[c]	210	Total Lead	0.1	0.3	200[c]	400
--	-	-	-	-					150[b]
Explosives – EPA SW-846 8330 (mg/kg)									
1,3,5-Trinitrobenzene	0.2	0.5	NA	1800	3-Nitrotoluene	0.2	0.5	NA	370
1,3-Dinitrobenzene	0.1	0.5	NA	6.1	4-Amino-2,6-dinitrotoluene	0.2	0.5	NA	NA
2,4,6-Trinitrotoluene	0.1	0.5	NA	16	4-Nitrotoluene	0.2	0.5	NA	370
2,4-Dinitrotoluene	0.1	0.5	0.86	120	HMX	0.1	0.5	NA	
2,6-Dinitrotoluene	0.1	0.5	NA	61	Nitrobenzene	0.1	0.5	40	20
2-Amino-4,6-dinitrotoluene	0.1	0.5	NA	NA	RDX	0.3	0.5	NA	4.4
2-Nitrotoluene	0.2	0.5	NA	370	Tetryl	0.1	0.5	NA	610

(a) All values are Region 9 Preliminary Remediation Goals (PRG) (Residential Soil) except where noted (U.S. EPA, 2002a).
(b) PRG reported is a California modified value (U.S. EPA, 2002a).
(c) This analyte is considered a Region 9 bioaccumulator (Hoffman, 1998).
(d) This soil screening value is from the RWQCB Tier 1 Lookup Tables (RWQCB, 2004).
(e) The listed reporting limit reflects the maximum sensitivity of current, routinely used analytical methods. It will be used during the project screening evaluation that is described in the Data Quality Objectives (Table 1-2).

RL = reporting limit. MDL = method detection limit. NA = not available.
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine

Table 2-7. Analytical Laboratory Reporting Limits for Groundwater (μg/L)

Analytical Parameter	MDL	RL	PRG[a]	Analytical Parameter	MDL	RL	PRG[a]
Petroleum Hydrocarbons – EPA SW-846 8015B (μg/L)							
TPH-D	600	1,000	NA	TPH-G	60	200	NA
VOCs – EPA SW-846 8260B (μg/L)							
1,1,1,2-Tetrachloroethane	0.2	1	0.43	Bromomethane	0.3	1	8.7
1,1,1-Trichloroethane	0.2	1	320	Carbon disulfide	5	15	1000
1,1,2,2-Tetrachloroethane	0.2	1	1[d]	Carbon tetrachloride	0.2	1	5[c]
1,1,2-Trichloroethane	0.2	1[e]	0.2	Chlorobenzene	0.2	1	110
1,1-Dichloroethane	0.2	1	340	Chloroethane	0.3	1	4.6
1,1-Dichloroethene	0.2	1	340	Chloroform	0.3	1[e]	6.2
1,1-Dichloropropene	0.2	1[e]	0.4				0.53[b]
1,2,3-Trichlorobenzene	2	5	NA	Chloromethane	0.3	1	1.5
1,2,3-Trichloropropane	0.3	1[e]	0.0056	cis-1,2-Dichloroethene	0.2	1	61
1,2,4-Trichlorobenzene	2	5	190	cis-1,3-Dichloropropene	0.2	1[e]	0.4
1,2,4-Trimethylbenzene	2	5	12	Dibromochloromethane	0.2	1[e]	0.13
1,2-Dibromo-3-chloropropane	3	5[e]	0.2[c]	Dibromomethane	0.2	1	NA
1,2-Dibromoethane	0.2	1[e]	0.00076	Dichlorodifluoromethane	0.2	1	390
1,2-Dichlorobenzene	0.3	1	370	Ethylbenzene	0.3	1	2.9
1,2-Dichloroethane	0.3	1	5[c]	Hexachlorobutadiene	1	3[e]	0.86
1,2-Dichloropropane	0.2	1	5[c]	Iodomethane	5	15	NA
1,3,5-Trimethylbenzene	2	5	12	Isopropylbenzene	0.2	1	NA
1,3-Dichlorobenzene	0.3	1	5.5	*m,p*-Xylene	0.6	2	210
1,4-Dichlorobenzene	0.3	1[e]	0.5	Methyl-*tert*-butyl ether	0.3	1	13
2,2-Dichloropropane	0.2	1	NA				6.2[b]
2-Butanone	5	15	NA	Methylene chloride	2.5	2.5	4.3
2-Chloroethylvinylether	5	15	NA	*n*-Butylbenzene	0.3	1	240
2-Chlorotoluene	0.3	1	120	*n*-Propylbenzene	0.3	1	240
2-Hexanone	5	15	NA	*o*-Xylene	0.3	1	210
4-Chlorotoluene	0.3	1	120	p-Isopropyltoluene	0.3	1	NA
4-Methyl-2-pentanone	5	15	NA	*sec*-Butylbenzene	0.3	1	240
Acetone	5	15	610	Styrene	0.2	1	1600
Benzene	0.2	1[e]	0.34	*tert*-Butylbenzene	0.3	1	240
Bromobenzene	0.2	1	20	Tetrachloroethene	0.7	2	5[c]
Bromochloromethane	0.2	1	NA	Toluene	0.7	2	720
Bromodichloromethane	0.2	1[e]	0.18	Trichloroethene	0.7	2	5[c]
Bromoform	0.2	1	8.5	Trichlorofluoromethane	0.2	1	1300
-	-	-	-	Vinyl chloride	0.1	1	2[c]
PAHs – EPA SW-846 8270C (μg/L)							
Acenaphthene	0.1	0.2	370	Chrysene	0.1	0.2	9.2
Acenaphthylene	0.1	0.2	NA	Dibenz(a,h)anthracene	0.1	0.2[e]	0.0092
Anthracene	0.1	0.2	1800	Fluoranthene	0.1	0.2	1,500
Benzo(a)anthracene	0.1	0.2[e]	0.092	Fluorene	0.1	0.2	240
Benzo(a)pyrene	0.1	0.2	0.2[c]	Indeno(1,2,3-c,d)pyrene	0.1	0.2[e]	0.092
Benzo(b)fluoranthene	0.1	0.2	0.092	Naphthalene	0.1	0.2	6.2
Benzo(g,h,i)perylene	0.1	0.2	NA	Phenanthrene	0.1	0.2	NA
Benzo(k)fluoranthene	0.1	0.2	0.92	Pyrene	0.1	0.2	180
RCRA 8 Metals – EPA SW-846 3051/6020 (μg/L)							
Arsenic	2	5	10[c]	Mercury	0.08	0.2	11
Barium	3	10	2600	Selenium	2	5	180
Cadmium	0.3	1	18	Silver	1	2	180
Chromium (Total)	2	5	NA	Total Lead	0.3	1	NA
Explosives – EPA SW-846 8330 (μg/L)							
1,3,5-Trinitrobenzene	0.5	1	1100	3-Nitrotoluene	0.5	1	61
1,3-Dinitrobenzene	0.5	1	3.6	4-Amino-2,6-dinitrotoluene	0.5	1	NA
2,4,6-Trinitrotoluene	0.5	1	2.2	4-Nitrotoluene	0.5	1	61

Table 2-7. Analytical Laboratory Reporting Limits for Groundwater (µg/L (Continued)

Analytical Parameter	MDL	RL	PRG[(a)]	Analytical Parameter	MDL	RL	PRG[(a)]
2,4-Dinitrotoluene	0.5	1	73	HMX	0.5	1	NA
2,6-Dinitrotoluene	0.5	1	36	Nitrobenzene	0.5	1	3.4
2-Amino-4,6-dinitrotoluene	0.5	1	NA	RDX	0.5	1[(e)]	0.61
2-Nitrotoluene	0.5	1	61	Tetryl	0.5	1	360

(a) Region 9 Preliminary Remediation Goals (PRG) (Tap Water) except where noted (U.S. EPA, 2002a).
(b) California modified PRG for Tap Water (U.S. EPA, 2002a).
(c) EPA's National Primary Drinking Water Regulation maximum contaminant level (MCL) (U.S. EPA, 2002b).
(d) California Primary Standards MCL
(e) The listed reporting limit reflects the maximum sensitivity of current, routinely used analytical methods. It will be used during the project screening evaluation that is described in the Data Quality Objectives (Table 1-2).
RL = reporting limit. MDL = method detection limit. NA = not available.
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine

Trip Blanks. Trip blank samples will accompany each cooler that contains groundwater samples being submitted for volatile parameter analysis. Trip blanks will be prepared at the analytical laboratory by filling volatile organic analysis (VOA) vials with DI water. Trip blanks are not to be opened in the field. Trip blanks will be analyzed for VOCs only if VOCs are detected in actual associated site samples. Trip blanks indicate whether the field samples have been contaminated during storage and shipping. The results of the trip blank analysis will be used to evaluate the field sample data in a manner consistent with the project DQOs.

Field Blanks. The purpose of field blanks is to detect possible contamination of groundwater samples from airborne contaminants during sample collection. Field blanks for groundwater sampling are collected daily and consist of three 40-mL VOA vials. To prepare field blanks, the VOA vials will be filled with DI water prior to collection of a groundwater sample, placing the uncapped vials upwind of the well during collection of the groundwater sample. Field blanks will be analyzed by the laboratory for VOCs only if VOCs are detected in actual groundwater samples.

Temperature Blank. Temperature blank samples will accompany each cooler that contains samples with a temperature preservative requirement. The temperature blank will be prepared either by the analytical laboratory or the field sampling crew by filling VOA vials with DI water. The temperature of the samples will be verified upon arrival at the analytical laboratory using the temperature blank.

2.5.2 Laboratory Quality Control. Laboratory QC is addressed through the analysis of laboratory QC samples, documented internal and external laboratory QC practices, and laboratory audits. The types of laboratory QC samples will be project/chemical specific, but may include laboratory control samples, laboratory duplicates, matrix spikes (MSs), surrogate standards, internal standards, method blanks, and instrument blanks. Matrix spikes, matrix spike duplicates (MSDs), and a laboratory control standard (LCS) are analyzed for every batch of up to 20 samples and serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs which are analyzed for organic compounds in order to evaluate the method's accuracy and to help determine matrix interferences. Definitions of each type of laboratory QC sample are listed in the following subsections. For laboratory measurements, if any of the QC checks are outside the acceptance criteria, corrective actions will be taken based on procedures outlined in the laboratory's QA Manual, or equivalent. The laboratory QC checks, acceptance criteria, and corrective actions are listed in Table 2-8.

Table 2-8. Quality Control, Acceptance Criteria, and Corrective Action

QC Sample Type	Acceptance Criteria	Corrective Action
Procedural blank	$<5 \times$ MDL	Results examined by analyst. Corrective action (re-extraction, reanalysis) or justification document.
Blank spike	80-120%	
Calibration	5-point calibration curve (RSD $\leq \pm$ 20%); mid-range NIST standard solution (RSD $\leq \pm$ 20%) (Battelle SOP)	Investigate the problem, resolve the problem, and recalibrate.
Calibration check	Mid-range calibration solution (RSD $\leq \pm$ 30%) (every 10 samples)	Investigate the problem, resolve the problem, recalibrate, and reanalyze affected samples.

MDL = Method detection limit is estimated from the lowest calibration standard solution. Samples below the MDL will be reported as not detected (ND).
NIST = National Institute of Standards and Technology.
RSD = relative standard deviation.
SOP = Standard Operating Procedure.

Laboratory Control Samples. Laboratory control samples include blank spikes and blank spike duplicates. Blank spike samples are designed to check the accuracy of the laboratory analytical procedures by measuring a known concentration of an analyte in the blank spike samples. Blank spike duplicate samples are designed to check laboratory accuracy and precision of the analytical procedures by measuring a known concentration of an analyte in the blank spike duplicate sample. Blank spike and blank spike duplicate samples are prepared by the laboratory using clean laboratory matrices spiked with the same spiking compounds used for matrix spikes at levels approximately 10 times greater than the MDL.

Laboratory Duplicates. Laboratory duplicates are two aliquots of a sample taken from the same sample container under laboratory conditions and analyzed independently. The analysis of laboratory duplicates allows the laboratory to measure the precision associated with laboratory procedures.

Matrix Spikes. MS and MSD samples are designed to check the precision and accuracy of the analytical methods through the analysis of a field sample with a known amount of analyte added. Additional sample volume for MS and MSD samples is collected in the field in the same manner as field duplicate samples. In the laboratory, two portions of the sample are spiked with a standard solution of target analytes. MS and MSD samples are analyzed for the same parameters as the field samples, and analytical results will be evaluated for precision and accuracy of the laboratory process and effects of the sample matrix. The number of MS and MSD collected from the field samples will be chemical dependent. A minimum of one MS/MSD will be analyzed each day that field samples are analyzed, at a rate of one per 20 field samples or one per batch, whichever is more frequent.

Surrogate Standards. Surrogates are chemical compounds with properties that mimic analytes of interest, but that are unlikely to be found in environmental samples. Surrogates will be added to all field and quality control samples analyzed for volatiles, analyzed by gas chromatography (GC) or GC/mass spectroscopy (GC/MS) to assess the recovery of the laboratory process, and to detect QC problems.

Internal Standards. Like the surrogate standard, an internal standard is a chemical compound unlikely to be found in environmental samples that is added as a reference compound for sample quantification. Internal standard procedures are used for the analysis of volatile organics and extractable organics using GC/MS and also can be used for other GC and high-performance liquid chromatography (HPLC) analytical methods.

Method Blanks. Method blanks are designed to detect contamination of field samples that may occur in the laboratory. Method blanks verify that method interference caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Method blanks are deionized water for aqueous samples, a clean solid matrix for soil and sediment, and clean filters or puffs for vapor and air samples. A minimum of one method blank will be analyzed each day that field samples are analyzed at the rate of 1 per 20 field samples. A method blank must be analyzed daily. The concentration of the target compounds in the method blank sample must be less than five times the method detection limit. If the blank is not under the specified limit, the source contamination is to be identified and corrective actions taken.

2.6 Instrument/Equipment Testing, Inspection and Maintenance (B6)

Various field instruments will be used during the field activities at the Navy's Ballfields Parcels at DoDHF Novato. Such instrumentation may include a water level indicator for measuring water levels in wells and a flame ionization detector (FID) (or equivalent) for measuring VOCs in off-gas samples. A list of field instruments that will be used during the field activities is provided in Table 2-9.

Table 2-9. Field Meters

Matrix	Parameter	Instrument
Groundwater from soil borings	Groundwater-level	Electric water level indicator or oil/water interface probe
Off-gas/head space	Organic vapors	Foxboro OVA-128 FID (or equivalent)

Field instrument maintenance will be documented in the field logbook for each field instrument used during field activities. Field equipment will be maintained when routine inspections indicate the need for maintenance. In the event that a piece of equipment needs repair, a list of the field equipment manufacturers' addresses, telephone numbers, and points of contact will be maintained on site during field activities. Field equipment routine maintenance may include the following:

- Calibrating equipment according to manufacturers' directions
- Removing surface dirt and debris
- Replacing/cleaning filters when needed
- Ensuring proper storage of equipment
- Inspecting instruments prior to use
- Charging battery packs when not in use
- Maintaining spare and replacement parts in field to minimize downtime.

The primary objective of a preventive maintenance program is to help ensure the timely and effective completion of a measurement effort by minimizing the downtime of crucial equipment due to expected or unexpected component failure. Laboratory instrument maintenance including standard preventive maintenance procedures and schedules are contained in, and will be performed in accordance with, the Laboratory Quality Assurance Plan (LQAP) and the manufacturer's instructions. Instruments will be constantly monitored by the use of daily standards, sensitivity, and response checks to determine if maintenance is required.

2.7 Instrument/Equipment Calibration and Frequency (B7)

Methods for calibration of field instruments will follow the specific instrument manufacturers' recommendations. All field instruments will be calibrated before each day of use; and a calibration check at the end of the day will be performed to verify that the instrument remained in good working condition throughout the day. If the calibration check at the end of the day does not meet acceptance criteria, then that day's data will be flagged and the instrument calibration checks will increase to the operator's satisfaction that the instrument remains true to the initial calibration.

Laboratory instrument calibration will be performed as specified in the method documentation. Specific laboratory calibration techniques are established for the U.S. EPA methods to demonstrate that the analytical instrument is operating within the design specifications and that the quality of the data generated can be replicated.

2.8 Inspection/Acceptance of Supplies and Consumables (B8)

Any supplies and consumables used in the sample collection process or instrument calibration, such as sample bottles, bailers, dedicated tubing, deionized water, calibration gases, etc., will be inspected upon receipt and prior to use. The sample tubing also should come with a certificate of acceptance. At a minimum, the Project Manager or a field team member will inspect the materials upon receipt for damage or broken seals.

The laboratories chosen to perform the analyses will be required to purchase and/or provide equipment, materials, and supplies that meet or exceed the requirements of the project and/or analytical methods. The laboratories will inspect their supplies and consumables prior to their use in analysis.

2.9 Nondirect Measurements (B9)

Nondirect measurement data are not anticipated as part of the field implementation or field decision-making aspects of this project.

2.10 Data Management (B10)

The purpose of the data management section of this SAP is to describe the procedures that will be used to maintain data quality throughout the project. These operations include, but may not be limited to, data recording, data reduction, and data reporting.

2.10.1 Data Recording. All field observations and laboratory results will be linked to a unique sample location through the use of the sample identification system. Field observations and measurement data will be recorded on the field forms and in a field notebook to provide a permanent record of field activities. All data that are hand-entered will be subjected to a review by a second person to minimize data entry errors. A check for completeness of field records (logbooks, field forms, databases, electronic spreadsheets) will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and the procedures specified in this SAP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.

2.10.2 Data Reduction. The data reduction procedures applied to reported data must be fully documented as follows:

- U.S. EPA Method: Data are generated and final concentrations are calculated exactly as specified in the method.

- Laboratory LQAP or SOP: The laboratory procedures, consistent with the U.S. EPA or other established methods, are fully documented in the laboratory's controlling records.

- SAP: If an unusual calculation is applied to the data and it is not documented in either the established method or the laboratory's standard procedure, then the full dimensional formula must be defined in the SAP.

2.10.3 Data Reporting. Hard copies of the data reports received from the laboratories will be filed chronologically and will be stored separately from the electronic files. Hard copies of data signed by a representative of the analytical laboratory will be compared to any electronic versions of the data to confirm that the conversion process has not modified the reported results. Any additional reporting formats will be completed and electronic and hard copies will be stored in different locations at the Battelle facilities.

2.10.4 Electronic Deliverables. Following the data review process, Battelle will enter the sample results into an electronic database. Battelle will submit an EDD to Southwest Division Naval Facilities Engineering Command (SWDIV) in DOS ASCII fixed-length tables described in current Navy Environmental Data Transfer Standards (NEDTS). In addition, data will also be submitted electronically to the California State Water Resources Control Board (SWRCB) using the Geographical Environmental Information Management System (GeoTracker) in accordance with Assembly Bill (AB) 2886. Data will be compiled with spatial and temporal qualifiers so that it will be possible to rapidly plot or review changes in the concentration of target analytes at each sampling point over time.

Section 3.0: ASSESSMENT/OVERSIGHT

This section describes the activities for assessing the effectiveness of the project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the SAP is implemented as prescribed.

3.1 Assessments and Response Actions (C1)

Assessments that may be performed during this project include, but are not limited to the following: technical systems audits, audits of data quality, and data quality assessments.

3.1.1 Laboratory Assessment and Oversight. Technical Systems Audits (TSAs) of the analytical laboratories will be conducted by the Battelle QA/QC Officer if required to assess compliance with QA procedures and SOPs. Results of the TSAs will be reported in an audit report to the laboratory manager. Technical systems audits and audits of data quality will be conducted periodically, if required, during site assessment activities by the Battelle QA/QC Officer. In addition, the Battelle Project Manager/ QA/QC Officer will conduct regular audits of the field and laboratory data as they are generated as well as data/sample collection procedures. This schedule of QA checks will require the cooperation of the laboratory regarding timely delivery of reports. However, it will ensure that data quality issues are identified early, rather than at the end of the investigation.

If significant variances are found during the audit, the Battelle QA/QC Officer may, at his or her discretion, conduct additional audits. Additional audits may include a visit to the laboratory, if required and if determined to be necessary by the Battelle QA/QC Officer. For those audits resulting in variances, the Project Team Leader or the laboratory coordinator will submit a response in writing to the Battelle QA/QC Officer. Reports will be submitted to SWDIV through the RPM.

Magnetic tape audits involve the examination of the electronic media used in the analytical laboratory to acquire, report, and store data. These audits are used to assess the authenticity of the data generated, and assess the implementation of good automated laboratory practices. Battelle may perform magnetic tape audits of the off-site laboratory when warranted by project performance evaluation (PE) sample results, or by other circumstances.

The analytical laboratory will participate in the U.S. EPA PE program, the National Environmental Laboratory Accreditation Conference (NELAC), and equivalent programs for state certifications. Satisfactory performance in these PE programs also demonstrates proficiency in methods used to analyze project samples. If the laboratory's performance is determined to be unacceptable on any individual portion of the PE evaluation, then corrective actions will be taken to locate the problem, identify the problem, implement corrective actions, and document these corrective actions. Once the problem has been identified and the corrective action implemented, the laboratory will purchase a blind, PE sample and analyze it for that portion of the evaluation.

3.1.2 Data Quality Assessment Report. Data collected during the field efforts will be reconciled with the project DQOs by preparing summary tables, charts, figures, or performing other types of data analyses that facilitate direct comparison of data collected through the entire extent of the project. Comparisons will be made on a parameter-specific basis, concentrating on the contaminants of concern. Comparisons also will facilitate an analysis of contaminant concentration trends through time and space.

3.1.3 Corrective Action. Corrective actions may be initiated by any of the participants of the data generation (field technician or laboratory analyst), reporting (laboratory director or field team leader), and validation process (Battelle Project Manager or QA/QC Officer). Note that it is important to generate corrective actions early in the process so that the problem has a greater chance of being resolved in a timely and cost-effective manner.

For field measurements, if the final calibration check is outside acceptable limits, then the associated data collected that day will be flagged. On the following day, a single point continuing calibration check will be run after every five wells monitored (or samples analyzed) to determine how long the initial calibration holds. Calibration frequencies will be adjusted accordingly.

For laboratory measurements, if any of the QC checks (MS, MSD, laboratory control samples, or laboratory blank) are outside the acceptance criteria (for accuracy, precision, and cross contamination), the laboratory will follow the corrective actions that are outlined in the LQAP.

3.2 Reports to Management (C2)

Project reports prepared by Battelle will be submitted to SWDIV through the RPM. The schedule and additional recipient list for submission of these reports following completion of remedial activities will be decided accordingly.

Section 4.0: DATA VALIDATION AND USABILITY

This section is divided into three elements that describe the QA activities that occur after the data collection phase of the project has been completed to ensure that data conform to the specified criteria and thus are useful for their intended purpose.

4.1 Data Review, Verification, and Validation (D1)

All project data will be reviewed by Battelle to determine if the qualitative parameters of representativeness and comparability have been achieved. In general, the review will be accomplished by comparing the chain of custody and field notebook entries with the data for the sample. If the reported concentrations of a field sample from a specific location do not reflect historical data, then efforts will be made to determine if the data reflect an actual change in environmental conditions at that sampling point, or if the integrity of the sample was compromised during collection, preservation, shipping, or analysis. Conversely, if some level of analyte historically present in samples from a specific location is no longer present, then similar efforts will be made to confirm that change in concentration. QA/QC requirements that bracket questionable data will be reviewed to confirm the performance of instrumentation during the time when questionable data were generated. Any deviations will be documented, and corrective actions will be taken to determine if the data meet project goals. If the data do not meet project goals, then the need for additional sampling and analysis will be determined.

The laboratory that generates the analytical data will have the primary responsibility for the correctness and completeness of the data. Before releasing any analytical data, the laboratory will review and verify that the data has met all of the method criteria and is scientifically correct. Data reviews include the evaluation of information, as presented by the analyst or staff member, for accurate representation of the samples submitted.

All data will be subjected to a tiered review process before it is released from the laboratory. First, the analysts will review the quality of their work based on established guidelines. This includes reviewing and performing the following activities:

- Calibrations, tunes, blanks, and any other instrument QC criteria were met during the analysis reported;
- Calculations of individual analytes and detection limits were met;
- Verify that holding times or extraction times were met; and,
- Make notes or footnotes on the report if abnormalities occurred during the analysis or any other QA/QC problems associated with the sample occurred.

The next step is performed by a supervisor or data review specialist whose function is to provide an independent review of data packages. This person will verify that all dates, sample identification, detection limits, reported analyte values, concentration units, header information, and footnotes or comments were transcribed accurately. This person will also check to ensure that data that do not meet project DQOs will be flagged with the appropriate data qualifiers. All information on the final report that can be verified against the chain of custody will be checked for errors and completeness.

The third step is done by the Laboratory Director or other designee who will sign the final reports. This person spot-checks activities associated with the log-in, tracking, extraction, sample analysis, and final reporting for technical and scientific soundness.

The Laboratory QA Manager then will review 10% of all data packages to ensure that all QA requirements have been met. This person will ensure that the data package is consistent and complies with project requirements.

4.2 Verification and Validation Methods (D2)

The data generated for a project will be reviewed and verified by the Battelle QA/QC Officer and validated by an independent outside reviewer (i.e., Laboratory Data Consultants). Data verification involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements and calculations. The data verification and reporting process for the field data involves ensuring that calibration of instruments, field blanks, and field duplicates defined in this SAP are within the acceptance criteria. The verification process for the laboratory data involves ensuring that the holding times, precision, accuracy, laboratory blanks, and detection limits are within the acceptance criteria outlined in the project-specific data quality plan.

The field and laboratory personnel will provide the Battelle QA/QC Officer with all the data. The Battelle QA/QC Officer will be responsible for overall review of the data verification results, for compliance with the specified DQOs. After this QC procedure is complete, the Battelle Project Manager will incorporate the verified data into the site assessment reports.

The data generated for this contract will be validated by an independent third party in accordance with SWDIV Environmental Work Instruction #1 (Chemical Data Validation). The data validation strategy is based on whether or not the Naval facility is on the National Priorities List (NPL) and is fully described by the U.S. Navy (2001). Since DoDHF Novato is not on the NPL validation will be conducted according to the following strategy:

- Non-NPL sites: 10% Level-IV and 90% Level-III data validation is required.

Note that third party validation of waste characterization samples is not required and will not be completed.

4.2.1 Level-III Data Validation. Level-III data validation assumes that reported data values are correct as reported. Data quality is assessed by verifying that the criteria defined in this SAP have been achieved for each compound class.

4.2.2 Level-IV Data Validation. Level-IV data validation is based on the assessment of raw data packages, which include all data required for a full review and assessment of compound selection, integration, interference assessment, and requantification (e.g., spectra and chromatograms). Supporting records are also included in the package (e.g., calibration standard, instrument sequence files, and dilution factors).

Level-IV data validation includes requantification of reported QC and field sample values using the raw data files. In addition, instrument performance, calibration methods, and calibration standards are reviewed to ensure that the detection limits and data values are accurate and appropriate.

4.3 Reconciliation with Data Quality Objectives (D3)

Data collected during the field efforts will be reconciled with the DQOs by preparing summary tables, charts, figures, or performing other types of data analyses that facilitate direct comparison of data collected through the entire extent of the project. Comparisons will be made on a parameter-specific basis, concentrating on the contaminants of concern. Comparisons also will facilitate an analysis of contaminant concentration trends through time and space.

Section 5.0: REFERENCES

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U.S. Navy. See United States Navy.

APPENDIX A

STANDARD OPERATING PROCEDURE FOR ENCORE^{TM} SOIL SAMPLING

The following sampling protocol was obtained from the United States Army Corp of Engineers (USACE), *Sample Collection and Preparation Strategies for Volatile Organic Compounds in Solids* (October 1998).

After the Geoprobe™ coring device is opened and a fresh surface is exposed to the atmosphere, the sample collection process should be completed in a minimal amount of time. Visual inspection and an appropriate screening method (e.g., PID) may be used to determine the interval of the soil core to be sampled. Removing a sample from a material should be done with the least amount of disruption (disaggregation) as possible. Additionally, rough trimming of the sampling location's surface layers should be considered if the material may have already lost VOCs (been exposed for more than a few minutes) or if it may be contaminated by other waste, different soil strata, or vegetation. Removal of surface layers can be accomplished by scraping the surface using a clean spatula, scoop or knife. When inserting a clean coring tool (i.e., Encore™ sampler or equivalent) into a fresh surface for sample collection, air should not be trapped behind the sample. An undisturbed sample is obtained by pushing the barrel of the coring tool into a freshly exposed surface and removing the corer once filled. Then the exterior of the barrel should be quickly wiped with a clean disposable towel to ensure a tight seal and the cap snapped on the open end. The sampler should be labeled, inserted into the sealable pouch, immediately cooled to 4 ± 2 °C and prepared for shipment to the lab. If samples are going to be shipped near the weekend or holiday, it is critical to coordinate with the receiving lab to ensure holding time of 48 hours for the EnCore™ sampler is met. Note that a coring device made from a disposable syringe cannot be used for storage or shipment. A separate collocated sample must be collected to determine moisture content.

There are advantages to this sampling procedure because weighing and the addition of preservatives in the field are not required. Because sample preparation is performed at the laboratory, exposure hazards and Department of Defense (DOT) shipping issues arising from the field application of preservatives such as methanol are avoided. However, samples must be stored at 4 ± 2 °C and prepared for analysis within 48 hours of collection. The short holding time for sample preparation usually requires additional coordination with the analytical laboratory and may incur additional costs. Furthermore, the sampling protocol will not be applicable to all solid environmental matrices. Some geological materials are impossible to core (e.g., gravels and hard dry clays).